This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Murray
1833
577

600042327O

33.

517.

PRACTICAL OBSERVATIONS

ON

THE PHENOMENA

OF

FLAME AND SAFETY LAMPS.

"—— alere Flammam."

BY JOHN MURRAY, F.S.A. F.L.S. &c.

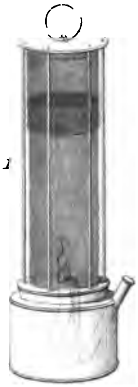
BIBLIOTHECA BODLEIANA

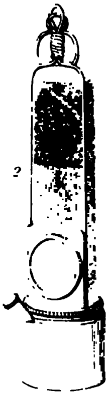
LONDON:
HOLDSWORTH AND BALL,
18, ST. PAUL'S CHURCH-YARD.

1833.

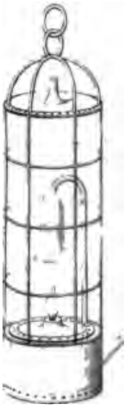
517.

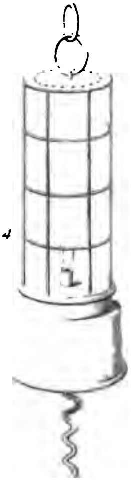
Smart and Parke, Wolverhampton.


1


2

5


3


4

J. Martin, 124 High Holborn.

TO

DR. WILLIAM RITCHIE, M.A. F.R.S.

&c.

PROFESSOR OF NATURAL PHILOSOPHY

IN THE

LONDON UNIVERSITY.

Dear Sir,

I venture to inscribe these few pages to you, as the memorial of friendship, and remembrancer of " auld lang syne."

Though lapse of years may change our circumstances, and dislocate our relations in life, there still remains a community of interests among the individual members of the republic of Science; and, cherishing, as we mutually do, the fond hope that her domain may be extended far and wide, and her influence felt and acknowledged, permit me to prefer the sincere wish that your contributions and researches may be appreciated as they deserve. Wishing you every success in this peaceful field of enterprize, where the victor's wreath is pure and spotless,

I remain,
Dear Sir,
Faithfully and obediently yours,
THE AUTHOR.

13th February, 1833.

DESCRIPTION OF THE PLATE.

Figure 1.—Sir Humphry Davy's Safety Lamp, as it is commonly employed by the miner.

2.—The same Safety Lamp, with Mr. Ellis's plano-convex lens, and supplied with a cylinder of talc, exterior to the wire gauze, leaving a space for the lens; the lower edge of the cylinder being half an inch above the inferior rim of the wire gauze, and extending nearly to the summit of the cage.

3.—Murray's Safety Lamp, founded on the principle that the products of combustion disarm an explosive mixture of fire damp and atmospheric air.

4.—Murray's Safety Lamp, the first mechanical invention ever proposed for this purpose, June, 1815. Its safety depends on the inferior specific gravity of the Hydrocarbonate, or fire damp of mines, compared with atmospheric air.

5,—Exhibits the structure and phenomena of flame, proving that it is a superficial film, and its interior filled up with inflammable vapour.

ADVERTISEMENT.

It is presumed that there can be no harm in preferring a claim to what belongs to me, but my chief purpose at present is to disabuse the public mind as to the views I have uniformly entertained on the Phenomena of Flame and Safety Lamps, and the share I have had in this question. As far as I am *personally* concerned, I should not have troubled the waters of forgetfulness, but I reflected, that haply much truth might be surrendered tamely to the authority of a name. Those who think by proxy are not merely cyphers as to the amount of usefulness, but become mischievous in sanctioning and perpetuating a spurious currency. If I have fearlessly scrutinized the view sustained by Sir H. DAVY, as to flame, and his theory of the wire gauze safety lamp, it is in the spirit of the advocacy of truth,—of one humbly contending for her rights. That Sir HUMPHRY DAVY did much for science, I would be the very last to dispute—that he adorned the age in which he lived, it is in vain to deny: his whole life, indeed, was one successful chain of brilliant discovery. Still, let us not forget, in this estimate of his worth and talent, that no individual in the circle of the sciences, or history of philosophy, possessed such imperial resources; unlimited means, and every encouragement and facility that mind could hope for, or its anxieties express, were at the Philosopher's disposal, and obedient to his nod;—that he used these advantages, with an ingenious dexterity, and to good purpose, the annals of Science amply testify. What I am anxious to substantiate is, that his opinions, though justly entitled to respect from all, should not be received as *infallible* in every case, or irreversible, like the laws of the Medes and Persians. Such a submissive spirit more assimilates to the prostration of the mind at the shrine of some Pagan Idol, than seems characteristic of those who acknowledge the axioms of inductive truth propounded by Lord **Bacon**—our illustrious pioneer. We are in some danger of being blinded by the dazzling blaze of our fellows, when they stand proudly pre-eminent above us, while fame wreaths her coronal and the acclaim of her trump is echoed in the hosannas of the multitude. We do well to distrust ourselves under such bewildering circumstances; and withdrawing from the brilliant focus, look abroad over the numerous luminous points that sparkle here and there in the hemisphere of mind, though struggling with almost overwhelming difficulties.

I have been often taunted with a too pliant and easy spirit, in permitting, unchallenged, so many to take advantage of the fruits of my researches, spreading over a period of nearly fifteen years—borrowed plumes, which their possessors have not the courtesy to acknowledge. I do not envy patentees and their precarious possession:—*tout au contraire*, and the confession may be easily believed. With all the allowances, however, which charity may be disposed to make, I cannot help fearing that the omission has, in some cases at least, had its root and origin in the belief that their author was forgotten, or consigned to "that bourn whence no traveller returns."

Paramount, however, to every other consideration is the hope that my present remarks may lead to the re-consideration of the subject, and eventually conduct to improvements in Sir Humphry Davy's Safety Lamp, by which its safety may be enhanced, if not made absolute, and its light materially improved. Let us remember that accidents in coal mines are fearfully on the increase, not only in frequency of occurrence, but in the amount of their victims. It becomes therefore a question of deep interest, how far such an increase is fairly attributable to a supposed perfectibility, a tacit, unchallenged acquiescence in the principles which have been assumed to account for the invention of the late Sir H. **Davy**. **The Thousands** who have witnessed my numerous and diversified experiments, have almost invariably admitted them to be conclusive against the views advocated by **Davy** and others. I may be mistaken;—some strange hallucination may have taken possession of my mind,—but *I* at least, pretend to no infallibility. Let me be convinced by the stubborn facts of experiment, and I resign my views and opinions without a sigh; while bare assertion, without such evidence, will weigh with me as little as a feather in the balance.

I had been for many years engaged in, unfortunately, the more abtruse researches of Chemical Science, but, differing as I did, in opinion, on the question now submitted, from certain individuals, and finding consequently a settled determination either to overlook or not award what belonged to me, and was hardly won, I abandoned the field in disgust, and thenceforth confined my exertions to the application of facts and principles to useful purposes in the economy of life—a task more pleasing to me than to be compelled to surrender the convictions of truth as the price of admission into the coteries of sect or party.—Even in the republic of science, where all should " live like brothers," there is, it must be confessed, an unhappy party spirit afloat, as virulent as any that mingles in the stormy region of politics.—" Ex uno disce omnes"—the alleged " decline of science" in England, in which as the *dramatis personæ*, we observe Messrs. BABBAGE and BREWSTER in array *versus* Messrs. FARADAY, DANIELL, and JAMESON, while VAN MONS, a continental philosopher, steps forward to shew that science has not declined in Great Britain, but that there is an evident declension on the continent of Europe.

PRACTICAL OBSERVATIONS, &c.

THE structure and phenomena of flame are interesting and beautiful, and the transit from darkness to light impressive. It is only because the spectacle and the transition are common, that they fail to charm or surprise.

In its form, flame assumes a conical shape, and is always upright or vertical, its spire is in incessant motion, waving to and fro, or shooting upwards; the more luminous portion appears encased by a dilute envelope, which however seems to possess, from its immediate contact with the surrounding atmosphere, more intense powers of temperature than the portion of flame it covers. Sometimes the exterior flame is beautifully tinged with colour; it is blue in the flame of *sulphuret of carbon*, which is changed into a fine rose colour, as is the case in that of sulphur, when immersed into nitrous oxyde. Flame is commonly white, more or less intense. Sometimes it is monochromatic, or of one colour; for instance, *blue* in the flames of cyanogene, carbonic oxyde, and hydrocarbonic oxyde, and *green* in a combination of equal parts of hydrogene and nitrous gas. Occasionally flame is party-coloured.

Flame in the common candle presents several interesting features besides those enumerated. It exhibits, beneath, a blue crescent figure with its concave surface upwards, and it is doubtful whether the luminous cone is in actual contact with the base on which it seems to repose, or from which it appears to spring. The inflammable matter, whether tallow, spermaceti, or wax, being melted by its nearness to the source of heat, ascends, in virtue of capillary attraction, by the fibres of the wick, where it is converted into inflammable vapour. In this manner is the flame fed and preserved in continuity. The wick serves the mere purpose of a ladder of ascent into the interior of the cone. So far as the wick is encompassed by the flame it is dark and carbonaceous, and only becomes ignited when brought in contact with the thin and dilute veil which mantles the more luminous portion of the flame; this may be effected by the flame being agitated, or the wick suffered to gain an ascendancy by its length. The melted inflammable matter, after its ascent, may be sometimes seen to boil on the surface of the wick,—minute bubbles of gaseous matter appearing to invest it. If the wick be cropped too low, the melted matter cups, or forms a basin which at length overflows: the reason of this is, that there is not a sufficient length of wick to promote its entire vaporization as fast as it is melted and can be supplied from beneath, the flame is, therefore, proportionally diminutive. On the other hand, when the wick is permitted to gain an unusual length, the expenditure of the inflammable material is so great as to be a consideration of some moment to the economist; besides, it does not yield a proportional degree of light,—on the contrary, the light is diminished by the excess of inflammable matter being more than can undergo a perfect combustion; fuliginous matter will consequently interfere, and reduce its amount of illumination. We believe this to be the true solution of the case, and should consider it superfluous to enter upon a confutation of some strange and wild reveries embodied in the article " Chemistry," forming one of the volumes of Dr. Lardner's Cabinet Cyclopædia, which acknowledges Mr. Donovan as its author. When we read the startling position of the *wick cooling the flame* by radiation, or in other words a cooling process going on in the centre of flame! "the decline of science" forcibly rushed on the imagination, and we thought this might be cited in proof that we are retrograding to the days of Alkemy. Still the *morale* is instructive, and shews how often common sense is surrendered at discretion to preconceived hypotheses and opinions. It is of importance to observe that flame, by a statical law, ever tends upwards.* The higher portion of the flame is more dense and opaque than the lower region, not, however, from any cooling virtue possessed by the wick, for it is the same in flames *without* wicks, but from its greater aggregation towards the summit of the cone, or more perfect combustion, as its temperature will be there found much higher. Through the lower portion of flame, from the attenuation referred to, we may easily read print or MS.; but it is accomplished with difficulty, if at all, through the higher section.

---

* Attention to this circumstance might be the means of preventing many a fatal issue when females' clothes accidentally take fire. Let the individual be instantly thrown down on the floor, and the flames are as immediately subdued. A few moments in an upright position are so many moments of imminent peril, which is rendered almost certainly fatal, if the individual endeavours to make an

Sir Humphry Davy assumed that flame, in all cases, was inflammable vapour or gaseous matter, possessing a temperature above the *white heat* of solid bodies. By a white heat is to be understood the maximum temperature that any solid body whatever can exhibit. Flame must, on this supposition, in every instance, and under every circumstance, be considered as far exalted above the highest temperature of solid bodies. The axiom, indeed, deduced by Dr. Ure from Sir Humphry Davy's sentiments, is this—"the temperature of flame is *infinitely higher* than that necessary for the ignition of solid bodies," and "that to a degree beyond the white heat of solid bodies." These are the *ipsissima verba*, and are quoted to show that I do not misrepresent the matter. The following is an inference resulting from this doctrine of flame. "Phosphorus, which rises in vapour at common temperatures, and the vapour of which combines with oxygene, at those temperatures, is always luminous, for each particle of acid formed, there is every reason to believe, must be *white hot!*" This is either truly alkemical, or not very intelligible. The position has novelty, but is nevertheless one which may be easily supposed to give rise to no ordinary share of scepticism in minds of plain understanding, and who do not profess to be adepts in these mysteries. The luminous matter which accompanies the slow combustion of phosphorus, *sub die*, evolving phosphorous acid, will

escape by the door-way, for the current of air imparts energy and power to the devouring element. With the simple precaution referred to, rugs or other wrappers are unnecessary, and closing crevices and crannies to prevent air from entering (the sage recommendation of some persons), equally useless and superfluous. In confirmation of this fact, let the following experiment be made:—Kindle a slip of paper—so long as it is held in a horizontal position its combustion is languid and its progress is slow; but if changed to the vertical position, it is forthwith consumed.

not materially affect the thermometer, a fact which may be determined by applying the phosphorus immediately to its ball. Phosphorized oil, if applied to the skin, is luminous, but imparts no heat. When we describe characters by means of a stick of phosphorus on the surface of a board or a sheet of writing paper, these traces are not charred, nor do we discern any evidence whatever of an impression of heat, and that the luminous acid matter must affect the surface is evident, since, if we use the blue or purple paper which envelops the sugar loaf, we shall observe that the characters impressed are *red;* acids turning vegetable blues to red. The lambent flame which arises from introducing heated glass rods into the vapour of ether, I found insufficient to kindle a stream of hydrogene, though this gas is readily kindled by an iron wire one fortieth part of an inch in diameter, heated cherry red. Rarely, if ever, does the dilute flame which accompanies the introduction of an ignited coil of platinum wire into the vapour of ether, kindle that vapour, though this flame sometimes exceeds two to three inches in length; indeed, when the ether is occasionally kindled, it is most probably effected by the platinum wire which will often approach a white heat: this is at least, the result of my own personal observation. Flames, therefore, burn with various intensities, and some at a very inferior temperature.

It is further inferred that "the flame of combustible bodies may in all cases be considered as the combustion of an *explosive mixture* of inflammable gas or vapour with air. It cannot be regarded as a mere combustion at the surface of contact of the inflammable matter. This fact is proved by holding a taper or a piece of burning phosphorus within a *large flame*, made by the combustion of alcohol. The flame of the taper or of the phosphorus will appear in the centre of the other flame, proving that there is *oxygene even in its interior part!*" On this last position (though founded altogether in error,) it may here be remarked that Lord Bacon had entertained an opinion on the constitution of flame precisely similar to that propounded by Davy, though he afterwards, in his "Sylva Sylvarum," refers to an experiment fatal to his previous conclusions, namely that a transverse slip of wood is only charred at the exterior edge of the flame. Sir Humphry Davy's error consisted in using a "large flame," where the phenomena are altogether equivocal and falacious; because in such a case, the flame becomes ragged, diffuse, and among its breaks and chasms, atmospheric air finds a ready entrance. I view flame in an aspect altogether different. *It is not solid.* In texture it is a film—a luminous bubble inflated with inflammable vapour. This view of it was first advocated by myself, contemporaneously with the late Mr. G. O. Sym. My remarks appeared in the Philosophical Magazine, and Mr. Sym's in the Annals of Philosophy; my results were obtained with a plate of glass, and Mr. Sym's with wire gauze. If there was any priority in the case, that priority was in my favor, since my view of the structure of flame was in the possession of the public on the last day of the month (when the Philosophical Magazine was published), while Mr. Sym's appeared in the " Annals of Philosophy," on the first of the succeeding month. The question is of little consequence, only let fairness be placed before favoritism ;* the merit in this case, therefore, to say the least of it, is a divided one.

That flame is a mere film, or entirely superficial, is rendered obvious when we press the top of the cone by means of wire gauze or glass, for we can thus see its interior structure, and when alcohol is set on fire in a hollow shell of glass, we obtain the same evidence by looking upwards. The interior of the cone is entirely filled up with inflammable matter in a state of vapour, subsequently consumed in its transit through the summit of the cone. The central figure in the plate, exhibits this fact in a very striking manner, and at the same time illustrates the method I usually adopt to prove the structure of flame. Figure V. shews the conical flame produced by igniting a portion of alcohol in a watch glass or small capsule; by introducing into this flame a glass tube, in an inclined position, as represented, inflammable vapour will flow through it and may be kindled at its upper orifice, while the insertion of another smaller tube into the secondary flame, as I shall venture to call it, will produce a third cone of flame at its summit. It is indeed interesting to remark that the phenomena merely, of the Safety Lamp, are entirely hostile to the view of flame sustained by its celebrated inventor, for the flame of the wick *disappears* when the safety cylinder is filled with the foreign flame of fire damp, so that the flame of the lamp does *not* appear within the other flame. In pursuing my experiments, I found that a taper, camphor, phosphorus, sulphur, or other inflammable substances, previously kindled, and introduced into the cone, figure V., were as effectually extinguished as if plunged into water. Even potassium, though it be *ignited* in the interior of the cone, exhibits no flame whatever; potassium will become red hot in contact with water, under an incumbent atmosphere of carbonic acid gas. Gunpowder may be introduced into the interior, and remain unexploded—less than a *white heat* will kindle gunpowder. I am aware that gunpowder is kindled with difficulty by flame, but it will be ignited if let fall through the edge of the flame: the platinum spoon, however, which I used in this experiment, had flame been solid, ought to have been instantaneously ignited sufficient for the inflammation of the gunpowder. Camphor vaporizes in the flame, and by its imparting an additional quantity of carbon, increases the illuminating power of the alcoholic flame, and this being a perfect combustion, no fuliginous matter escapes, as is the case with the combustion of camphor *per se.**

---

* Thus Mr. Children in his work " on the blow-pipe," assigns the discovery exclusively to Mr. Sym, without the slightest allusion to my name, and Dr. Thomson as incessantly harps on the same string.—My remarks amounted to these.—The cone of flame may be considered a film. By pressing the apex with a plate of glass, we get an insight into its interior, while transverse sections may also be obtained. By allowing alcohol to burn on a piece of glass, slightly concave, we ascertain the form of the base, and diameter of the film of flame.

If we stretch a thread of platinum wire across the cone of flame, it is only ignited at the outer edge, while it remains unignited between. In this arrangement, I connected the wire, at both ends, with the poles of a galvanic battery, when a brilliant ignition darted through its entire extent. A slip of paper is only charred and inflamed at the exterior edge of the flame. A straw illustrates this very elegantly, for the straw will be inflamed and burnt through, while the central portion will remain entirely uncharred, and drop down unchanged into the middle of the flame. Phosphorus may be vaporized in this flame, but if a stream of common air or oxygene be brought into immediate contact with the phosphorus, sustained in the interior of the cone, then the phosphorus will emit flame at the point of contact. I placed a small chip of phosphorus on a disc in the centre of the orifice of a gas pipe;—the gas was suffered to flow, and then kindled—the phosphorus remained flameless—the gas was now turned off, and the phosphorus burnt; but on allowing the gas to flow again, the gas was inflamed, while the phosphorus was simultaneously extinguished. Indeed I introduced a small tube of glass containing water into the cone, where it was *boiled*, and evaporated, and evidently increased the energy of flame. I hence inferred that the time would likely come when water might be employed as an article of fuel, and this opinion was given in my Lectures at the Surry Institution, in 1818, and in that year published in Newton's "London Journal of Arts."*

---

* This beautifully illustrates one mode proposed for consuming smoke. The smoke from the combustion of common coal in the furnace, after traversing the horizontal flue, passes through an iron grating which supports ignited coke, and the smoke is thus consumed before it ascends the vertical chimney.

From my foregoing remarks, it is very evident that flame is a mere gossamer tissue, and contains within itself no supporter of combustion whatever, in a free form. I consider the phenomenon under common circumstances to be the tranquil exhibition of ignited vapour or gas, entering into new chemical arrangements, while the continuity of flame, at an uniform temperature, supports these continued successive changes.

The *colour* presented by certain flames has been pronounced expressive of the solid base dissolved in the inflammable material; carbon communicates to flame whiteness more or less intense, according to quantity, and of which olifiant gas, and the new combination of carbon and hydrogene obtained from oil gas, by Dalton, afford brilliant examples, when contrasted with the low illuminating power of fire damp, or protocarburetted hydrogene. Nitrate of strontia dissolved in alcohol supplies a *red* flame; muriates of lime, soda and baryta, various tints of *yellow* or *orange*. Indeed, muriate of soda, dissolved in alcohol, yields the flame which is the illuminating medium in Dr. Brewster's monochromatic lamp. Boracic acid, and nitrate of copper, in alcohol, present *green* flames, and I find that a solution of chlorine, nitric, and hydrochloric acids in alcohol, yield blue and party-coloured flames. The introduction of solid matter into flames of inferior illuminating character increases their light, as for instance, a coil of platinum wire into that of hydrogene.

---

* Subsequent to this it was tried on a large scale, at my suggestion, by Mr. Bankes, of Bewdley, in Worcestershire, in the furnace of his steam engine. A few years ago, a patent was taken out by a person of the name of Evans, for this very application of water to aid combustion! — by which, it is stated, there is a saving of 40 to 50 per cent.

The illuminating power of flame is altogether irrespective of temperature. In its ratio of temperature, the flame of hydrogene is much higher than that of olifiant gas. The flame of *sulphuret of carbon* I have found to exceed in temperature that of almost every other, simple or unexplosive flame;—steel wire is beautifully deflagrated in this flame, forming an elegant experiment. In the flame of the compound gas blow-pipe, we perceive a power almost irresistible. The late Dr. Clarke, of Cambridge, informed me he had, in one experiment, no less than an ounce weight of platinum in a state of perfect fusion in it. With it I succeeded in *fusing* the *diamond*, which seemed to be as completely *liquid* as a globule of oil, when acted on by a minute stream of air, and the jet of flame seemed actually to impress the fused portion of the diamond. With this powerful though dangerous apparatus I also melted two *emeralds* into one limpid mass. The flame, in this instrument, however, is probably *solid*, from the close contact of the inflammable matter, and the supporter of combustion.* The light produced when this compound flame is forced to play on calcined lime or magnesia, is exceedingly dazzling, indeed altogether overpowering, by its splendor. The principle has been made subservient to a most valuable purpose, namely—the measurement of the base of the triangle in the grand trigonometrical survey of the British Isles. Lieutenant Drummond, I believe, first suggested this application of the intense light, obtained from chemical means. In his experiments made in the Tower of London, a ball of calcined lime, surrounded on all sides with minute jets of the flame of alcohol, were propelled on the central ball of quicklime, by oxygene, as so many radii, converging towards a centre. An officer of the Royal Engineers informed me that this light was seen from one of the mountains of Morne, in Ireland, at a distance of not less than sixty miles! For the light-house, and night telegraphic signals, this light seems pre-eminently well cal-

---

" Stearine Candles," as they are called, have their wicks previously dipped in a solution of *nitre*, or *chlorate of potassa*, as recommended by me in Dr. Brewster's " Edinburgh Journal of Science," some years ago,—the combustion is more perfect, and the light more brilliant.

culated—the intelligence might have reference to its periodic duration and repetition.

The temperature of flame, agreeable to our previous remarks, has been assumed to be superior to that of a *white heat* in solid bodies, and the intonation of hydrogene and other gaseous flames in narrow tubes of glass, porcelain, &c., has been ascribed to its "being in *all cases* an explosive mixture of inflammable gas, or vapour with air." We also from the same quarter, read of "inaudible explosions," which is, however poetical the expression, a contradiction in terms, and perfectly incomprehensible. It may be replied—"What's in a name?—a rose by any other name would smell as sweet."—True, it would, but words are the expressive symbols of thought, and should have a definite and unchangeable meaning attached to them. The phenomenon is more satisfactorily explained on the principle of vibrating currents of air entering the tube from below. It is evident that the flame is in a state of vibration, and when the tube is heated that vibration is increased, and the intonations become louder and louder. "When an attempt," it is stated, "is made to pass flame through a very fine mesh of wire gauze of the *common temperature,* the gauze cools each portion of the elastic matter that passes through it, so as to reduce its temperature below that degree at which it is luminous." This is not very intelligible language;—"common temperature" seems to belong to the wire-gauze, and flame appears to be described as "elastic matter,"—this is the sense at least in which I understand it. At any rate it seems evident that Sir Humphry Davy ascribed the curious phenomena of his safety lamp to a *cooling* influence or power inherent in the wire gauze. Should a specific temperature, therefore, be necessary for the constitution of flame, it would be extinguished, or it would cease to be, on a reduction of that temperature. This idea of the cooling influence of the metallic tissue as explanatory of the phenomena of Sir H. Davy's invention, it should be, however, stated, did *not* originate with Sir H. Davy, but was suggested by a correspondent in the "Annals of Philosophy," under the signature "Oxoniensis."

The wire gauze can be supposed to *cool* the flame only in two ways—either by *radiation* or *conduction.* Though it should be granted, *causa argumenti,* to wire gauze at the "common temperature," it is not quite so evident how *red hot wire gauze* could cool down flame, and intercept its passage, though I have had the Safety Lamp *red hot* in the passages of the mine[*] where an explosive atmosphere prevailed. In a very early stage of this enquiry, I found that sieves of *pasteboard*, *haircloth*, and *muslin*, intercepted flame, and in 1818 proved these facts experimentally, in my public lectures at the Surry Institution. These being non-conductors of caloric, it is evident that the question is reduced to the alternative of *radiation*, and this in them is not sufficiently powerful to account for the phenomenon. Since that period, I had a net work tissue of transparent *glass*, and found that this, in like manner, intercepted flame. I dipped a piece of muslin into a solution of *phosphate of ammonia*, and having dried it, formed it into a Safety Lamp, when it was proved to be as safe, when immersed into an explosive atmosphere, as one of wire gauze. Signor Libri, of Florence, accounts for the phenomena of the Safety Lamp on principles altogether different from those of Sir H. Davy. Flame, he observes is repelled by metallic surfaces, and that to a certain extent; if two parallel wires be brought within a specific distance, this repulsive void will be maintained, and flame will not pass through. He therefore finds that parallel wires will as effectually intercept flame, as when woven into meshes. Mr. Dillon's (of Belfast) improvement on the Safety Lamp consists of a shield of *talc*, forming an external semi-circular attachment, and its object is to PREVENT the cooling of the lamp by screening it from the current of air which flows through the passages of the mine, in the process of ventilation; he has thus shewn that *gas* may be safely burnt in the lamp. It seems, therefore, evident that the principle of safety cannot depend on any cooling influence whatever, whether it be connected with conduction or radiation. Accordingly it is found that when the Safety Lamp is newly lighted, and is consequently more cool than at other times, it is very apt to explode the air of the mine, and will kindle a stream of hydro-carbonate, under such circumstances, even when *six folds of wire gauze interpose*, while it will not permeate ONE such fold if the lamp be HOT. The rarefaction or attenuation of the inflammable and explosive atmosphere seems to be the real truth of the case.* When an explosive atmosphere is condensed, its explosive powers are more forcible, and its range more extensively destructive; on the other hand, when it is rarefied or attenuated, its violence is proportionably diminished. The heated walls of the wire gauze which imprisons the flame, will attenuate the elements of explosion, and they will become feeble in consequence. The Chevalier Aldini's fire-proof apparatus, recently introduced, renders altogether problematical, if not entirely nugatory, the cooling theory, though the repeated objections we brought against it, from the period when the proposition was first started, had been entirely disregarded. Aldini's experiments made at Geneva, and since repeated at the Royal Institution, seem to have startled the advocates of the theory referred to, and seeing that cloth of amianthus is a non-conductor; cooling by conduction, the note that was struck in past times, is abandoned, and its cooling influence as a *radiator* is now contended for. The latter is just as powerless as the former. Why should Chevalier Aldini's experiments, proving that flame would not pass through the meshes of amianthus cloth, make those who contend for the cooling theory, more restless than my experiments with meshes of *hair cloth*, *pasteboard*, &c. publicly exhibited in 1818? Their nature is precisely the same—they are equally adverse to the theory that has been indulged in, and so long clung to, with remarkable tenacity. The *name* of Aldini, has however, broken the spell of these dreams. My friend, Dr. Wilkinson, of Bath, thus writes me.—"The Chevalier Aldini has sent me his fire-proof dress of asbestos and wire gauze. I have a cap, coat, and pantaloons, of asbestos fabric, and have twice exhibited a man in Sidney Gardens, walking through an avenue of flame, twenty feet in length, and other experiments, evincing the resisting power of heat. A portion of asbestos cloth, with meshes considerably larger than the wire gauze protectors, resists completely the passage of flame, although a bad conductor, and of no great radiating power; this is not reconcilable with Davy's theory."†

---

[*] It providentially happens that the "Fire-damp" of mines is among the least inflammable of the gases, or, more correctly speaking, the least susceptible of inflammation.

---

* I purposely overlook the experiments of Von Grotthus, as not affecting this question.

† Madame Lena Carpenti, of Como, used formerly to weave amianthus cloth;—the amianthine fibres are mixed with flax, cotton, or silk, and thus

Sir H. Davy's Safety Lamp consists of a cylinder of wire gauze, surrounding a wick supplied with oil from the cistern below; a bent wire, movable from without, and passing through the lamp, serves to adjust and trim the wick without the necessity of unscrewing the cylindrical cage. The cistern is supplied with oil through an external pipe, reaching to the bottom, the orifice being closed by a screw nut. Figure 1 represents the appearance of the first wire gauze Safety Lamp. The gauze contains 625 apertures to the square inch, about one-twentieth of an inch square in the mesh. It is supplied with a double top from the increased energy of flame in that direction. Mr. Daniel Ellis, of Bath, applied a plano-convex lens, *exterior* to the wire gaze, by which the miner obtains a concentrated supply of light in that particular direction. This attachment is certainly an improvement. Mr. J. Roberts has further supplied the lamp with reflectors. Roberts has inserted a reflector behind the flame of the wick.—It is concave, but of no precise mathematical curve. In particular cases, Roberts employs a second concave reflector *externally*, movable by a jointed rod to direct the rays of light, concentrated by the interior reflector, in any required direction. Dr. Murray, of Scarborough, informs me, he had some time ago suggested the employment of an interior concave reflector, and, we believe prior to that of Roberts. We can see no possible objection to the employment of a parabolic reflector immediately behind the flame of the lamp, and opposite the plano-convex lens, the invention of Mr. Ellis; and have experimentally proved that, by these means, the miner may receive a vast accession of light compared with his present scanty supply. In order to maintain the rarefaction produced by the heated wire gauze, and prevent its being cooled by currents of air (especially when used as an exploring lamp,) as well as that rushing through the galleries, impelling the flame of the wick

woven together. The cloth is then cast into the fire, which leaves the amianthus untouched, and consumes the rest. Fine specimens of amianthus are obtained in Corsica,—soft and silky, and the fibres of considerable length. I possess a singularly beautiful specimen from that island. The amianthus is previously exposed to the action of steam, in a vessel which will contain 3000 pounds of the mineral: by these means, the fibres become flexible, and are easily separated:—the individual fibre is as fine as silk, and generally about four inches long.

against the sides of the cage, when the lamp is in motion, I clothe the cage from without, with the exception of the space occupied by the plano-convex lens, with a sheet of thin transparent talc.* It is sufficient that the talc be about an inch from the socket into which the wire gauze is inserted, to allow the air to enter the lamp, and support combustion. This cylinder may reach within a short distance of the top of the cylinder, see Figure 2 of the plate. Sir Humphry Davy also recommended a small cage formed of platinum wire to be suspended from the top; this will glow with an aphlogistic light, when flame cannot obtain by excess of fire-damp, and I suggested its more direct and immediate application to the wick, forming a zone of metallic rings, a small distance apart, from the body of the wick flame, and extending a little above it. This arrangement will *rekindle the lamp* when the confines of danger are passed. The mere suspension of the platinum cage from the roof, as anticipated by Sir H. Davy, will scarcely effect this purpose. This was the only arrangement in the Safety Lamp shewn me in the laboratory of the Royal Institution, and such were the lamps supplied by Mr. Newman, of Regent-street.

It is essentially necessary to safety that the wire gauze should be of IRON, and not of *copper*,—a most important precaution, which, though I publicly pointed out in the earliest stage of the invention, for many years had been altogether disregarded, having only RECENTLY received that attention which its paramount importance demanded. I found, when using a *copper* Safety Lamp in the mine, that the flame of the fire-damp acted with great violence on the meshes which were consequently materially weakened, and the fact that a copper Safety Lamp, introduced into an explosive atmosphere of hydro-carbonate, finally exhibits an encaged *green* flame, is conclusive evidence of its danger. A familiar example may be obtained by the introduction of such a lamp into a vessel containing a supply of the vapour of ether, arising from the introduction of a small portion of liquid sulphuric ether. I would further recommend, on a galvanic principle, two belts formed of ribbons of *zinc* to the iron wire gauze, to prevent the effect of coroding agents, and the oxydation and decay of the metallic tissue.

---

* A mineral product, extremely flexible, thin, and transparent, and obtained in great abundance in Siberia. It is used on board Russian ships of war, as a substitute for glass,—not being liable to fracture from the concussion produced by the firing of cannon.

When the Safety Lamp is introduced into the workings of a mine where the fire-damp prevails, the flame of the wick will be perceived to shoot upwards into a lengthened spire,—a dilute lambent and extraneous flame is then seen to encompass the flame of the wick, which last finally disappears, and the cage is then entirely possessed of this foreign flame, which flutters for a while—and if there be an excess of fire damp, soon expires in a feeble gleam. Such are the phenomena which invest the Safety Lamp in the fiery wastes of the coal mine. The presence of fire damp, in mines, is indicated by what the miner calls the "candle-top." When the apex of the flame is *blue*, the fire-damp prevails, and the *length* of this blue summit determines the comparative danger. This *blue flame begins to dance* on the other flame prior to an explosion. It is worthy of remark, that such parts of a mine as cannot be entered without imminent risk when *cold*, cease to be dangerous when WARM. The miner, therefore, enters the place *without a light*, and falls to work; when by his laborious operations the waste becomes heated, he introduces his candle, and as soon as the place from any cause, such as intermission from labour, is suffered to cool, the blue top makes its appearance, and warns the miner of his danger. All these circumstances, taken in connexion with what has already been advanced, shew clearly that the cooling influence has a problematical existence. Many years ago, I proposed a SAFETY URN for consuming the fire-damp on the spot, without risk or danger, and the more I reflect on the conditions of safety, the firmer are my convictions of its efficacy. *Heated air*, *steam*, or a mixture of *carbonic acid gas*, or *azote*, disarm an explosive mixture of fire-damp and atmospheric air of its violence,—all these advantages are secured in the "Safety Urn."

That the Safety Lamp of Sir H. Davy is under proper circumstances and precautions—what it purports to be, a *Safety Lamp*—there can be no doubt. Perhaps the severest test to which the invention was ever subjected was in an experiment instituted by myself. While the fire-damp, in the mine, was burning in the cylinder, I projected against it a considerable quantity of lycopodium, a highly inflammable powder, which, however, simply flashed in the cage.* The miner complains of the feeble light it yields, and it must be admitted there is much cause for complaint; it is even to be feared that he may sometimes, in reckless hardihood, be inclined to play the fool on the brink of destruction, by discarding the safety provided for him, in unscrewing the cylinder from its socket.

A comparative estimate of the number of explosions and loss of life, in the British collieries, for the *ten* years preceding the invention of Davy's Safety Lamp and the *ten* years succeeding that period, we regret to say, is disadvantageous to the latter. From 1805 to 1816 there were nine explosions, accompanied with a loss of life amounting to 284; and from 1817 to 1828 the number of explosions amounted to nineteen, and the loss of life 360, being an excess since the invention, of ten explosions and seventy-six lives, and we doubt that the catalogue, if extended to the present period, would be yet more eventful,—witness the loss in the "Croft Pit," at Whitehaven, and numerous others. We are certainly afraid that confidence in this invention has imprudently relaxed a proper attention to ventilation; but, it must be granted, that the inventor is not chargeable with any *abuse* to which the invention may give rise. It was never intended to be a *substitute* for ventilation, and if this last be neglected, the inventor must not bear the blame.† It should be observed that the danger in mining is now increased from a variety of causes. Old workings can be explored, and excavations extended incomparably farther, than could be done before,—so that if ventilation be neglected, or only regarded as a subordinate affair, while the safety which scientific skill has provided, is discarded or despised through ignorance, or a bold and criminal defiance of danger, it is evident the amount of danger and destruction must be fearfully enhanced. To the causes of accident, where the Safety Lamp is in general use, (it is in vain to deny that explosions have occurred with it), must be added the *indiscriminate* employment of *copper* and *iron* Safety Lamps, and the mere occasional use of the lamp—for instance—as an exploring lamp:—The catastrophe in the Jarrow Colliery, wherein fifty lives were lost, affords an unhappy illustration of the danger attendant on an *occasional* employment of the lamp. It appears that the workmen, without any previous indication, during the operations of mining, came unexpectedly on what might be called a natural gazometer of fire-damp, where it may have been pent up for ages. The lamp, *newly lighted*, and carried into wastes charged with an inflammable atmosphere, might kindle that atmosphere, on the principle already suggested, in consequence of its *coolness*. When we traverse the avenues of a mine, the current of air will impel the flame towards the side of the cylinder, and the wire gauze meshes being acted on by this impulsion of flame, as by a blowpipe, (rendered still more intense if an explosive atmosphere prevails), would soon ignite the tissue of iron wire sufficiently high to kindle the external atmosphere of the mine, if, indeed, it did not altogether fuse the meshes at the point of contact, and liberate the imprisoned flame. It is quite true that iron wire, even red hot, is insufficient to kindle fire-damp; but it is equally true that iron wire, at a *white heat*, will effect its inflammation, as is proved to have been sometimes the case, even in the sparks elicited from the "steel mill" in use previous to the invention of the Safety Lamp, and employed to yield a precarious light, in re-establishing the arrangements of ventilation destroyed by an explosion of fire-damp. The sparks emitted by this collision of flint and steel, flying off in a state of high incandescence, occasionally kindled the explosive air. The cylinder of talc, recommended, entirely prevents this impulsion of flame, as currents do not affect it, the flame remaining always upright and steady.

---

* The seed of the *lycopodium clavatum* or club-moss.

† The excellent papers of Menzies on Ventilation have not met with the attention they deserve. The insulation of the coal field, as proposed by Mr. James Ryan, is perhaps too expensive for general adoption, though the plan seems to be one which promises to be very serviceable.

Enough, perhaps, has been advanced to prove that whatever may be the cause of the phenomena of the Safety Lamp, and they are curious and interesting, a pre-supposed cooling influence will not solve the problem of these wonders. It is proved that the lamp is most dangerous when most cool, and, on the contrary, is entirely safe when it is HOT. It will surely scarce be contended that the wire gauze is either a better conductor or a better radiator, or will cool flame more efficiently, or more rapidly, when that gauze is *red hot*, than when it is at "the common temperature?" I have used the lamp in explosive atmospheres in the mine, when RED HOT, and the result proved its entire safety; I even carried it about with me when exploring the wastes. A coal proprietor, in Yorkshire, assured me that his workmen have repeatedly worked when their lamp was red hot, and continued so; the red hot wire will not kindle the fire-damp, and the only danger arises from particles of coal being blown against it,—such particles being thereby kindled, and becoming a medium of danger,—this source of hazard is also entirely obviated by the talc. The chief and almost exclusive experiment adduced to prove that the metal must needs exert a cooling influence, is that of bringing a coil of platinum wire, with an extremely fine mesh or opening, over a fibre of cotton, coated with wax, forming a miniature wax taper;—when this is inflamed, and the platinum wire is *cold*, the flame, it is stated, is extinguished, but if the metallic coil be red hot, the flame passes through. Not to mention the extremely equivocal nature of this experiment, it must not be forgotten, that platinum is one of the worst metallic conductors of caloric, and the coil would be little else than an insulated orifice, while ignited platinum would readily kindle the inflammable matter that passes through the coil, independent altogether of the transit of flame, which, in such a case as this, it would be extremely difficult to detect. In viewing the foreign flame of fire-damp, resulting from the explosive elements which have entered the cylinder, we perceive that it not only does *not explode* within its prison walls, but exhibits the phenomenon of a quiet or tranquil flame, more dilute, and otherwise varying very materially in its aspect from the flame of simple hydrocarbonate or fire-damp. It must, therefore, it is natural to suppose, have undergone some considerable change, from an admixture of other gaseous matter.

It has been experimentally proved, that if an explosive atmosphere of fire-damp; that is, when the atmospheric air becomes impregnated with fire-damp to the amount of from one-seventh to one-twelfth of its volume, for these limits embrace the explosive range, and this again be mixed with a small proportional of *azote* (nitrogene), or carbonic acid gas, the mixture will, in such a case, NOT EXPLODE, but burn with a tranquil flame, having all the characters of that in the Safety Lamp. It must be remembered that the products of the combustion of the wick are *azote* and *carbonic acid gas*, and they have no way of escape except through the meshes by which the explosive atmosphere enters. The elements of explosion, therefore, will be partially mixed with these products, and hence cease to be explosive. The continued tranquil flame which plays within the cage, is thus accounted for. If to this be added the attenuation of the gaseous mixture by the heated walls which confine it, and both be combined with the circumstance that flame is a *film*, and such a texture necessary to its existence, there seems to be little difficulty in solving the appearances of the Safety Lamp. It is evident that flame could not pass through a minute orifice, and preserve its texture, as it would become *solid*, and therefore cease to be.

Believing that the phenomena of Sir H. Davy's invention were connected with these principles, I constructed a Safety Lamp, represented in figure III. of the plate. It consisted of an air-tight lamp, composed of thick concentric cylinders of glass, separated by a very narrow partition to contain water, which, by its evaporation at top, preserved the inner cylinder at a uniform temperature. Minute orifices at the summit of the dome permitted the excess of heated air to escape. The air destined to support the wick-flame entered a circular orifice in the centre at the base. An inverted bell over the flame of the wick received part of the products of combustion which were conveyed by a prolonged tube, and re-entered from below, mingling with the explosive atmosphere. The phenomena presented by this invention were instructive, for they were precisely similar to those of the Safety Lamp of Sir H. Davy, and when the fire-damp exceeded in quantity, the gaseous products collected by the bell predominated in a ratio to cause the immediate extinction of the flame within the lamp. This Safety Lamp is figured and described in the "Edinburgh Philosophical Journal" for 1824. It is the basis or ground-work of a *patent* taken out by Mr. Richard Witty for a furnace by which the smoke separated from the coal, is reconsumed, in passing again through the coal thus deprived of its gaseous matter, (then necessarily in the state of ignited coke). By the evidence of the Earl of Shrewsbury, these furnaces have succeeded at Alton Towers. It should be observed that Mr. Witty witnessed the experiments I made with my invention, and he has admitted to a certain extent, that the hints, &c. were received from me. If further evidence were requisite that a metallic tissue is by no means necessary for these effects, the phenomenon of the "gasing of lace," amply supplies it. In this case the lace is passed over the flame of coal gas, which has no more power to pass through the meshes, than if the lace were composed of metallic threads.

The production of fire-damp in mines has been ascribed by Mr. Longmire and Sir H. Davy to the *high pressure* under which coal has been originally formed. This deduction is the language of hypothesis and mere assumption, not the calm inference of sober philosophy. Of the circumstances under which coal *has been* formed, we know nothing certain,—the tacit deference of silence is more worthy of legitimate science than the unwarrantable dogmatism of bold and forward speculation. When coal is simply broken under water, bubbles of proto-carburetted hydrogene, or fire-damp, are liberated. *Dykes*, *faults*, or *troubles*, as they are termed by the miner, dislocate the seam of coal, depressing or raising the stratum; these vertical walls fracture the coal or crumble it to fragments, and the mechanical agency of such basaltic or whinstone dykes, seems sufficiently to account for the liberation of the fire-damp. As we approach them, the coal loses more and more its integrity, fire-damp is disengaged abundantly in their vicinity, and on the miner's approach to them. The fire-damp is discharged into the mine by what are called "blowers" in the seam of coal. In several instances, this disengagement has continued, without intermission, for many years. It sometimes issues with considerable force, distinctly audible, while, at other times, the fire-damp insinuates itself more silently and slowly. From its superior specific levity it ascends to the roof, and there floats incumbent on the atmospheric air, or lodges in cavities. Here we have witnessed it ignited, forming a sheet of flame rolling far and wide, but the experiment is not without its attendant danger as it might conduct, by some train, to dangerous recesses, charged with explosive air. The currents in the air passages, in the process of ventilation, though they tend to sweep away the stagnant atmosphere and renew the air, may also mingle the ingredients which constitute the elements of explosion, conformable to the limits we have already stated. The picture of misery and distress consequent on these terrible subterranean explosions, cannot be better described than in the language of the Rev. Mr. Hodson, who drew up a luminous statement of the accident which occurred at "Felling Colliery," near Newcastle. This mine exploded on the 12th of May, 1813, and swept away ninety-eight human beings, under circumstances the most awful, into the abyss of eternity: notwithstanding, redoubled efforts on the part of the proprietors, and all the talent and experience of the engineer enlisted into the cause, a second explosion occurred, after an interval of only nine months, and added thirty-seven to the frightful catalogue. "When," says Mr. Hodson, "the air has proceeded lazily through the workings of the mine, and an extensive magazine of fire-damp becomes ignited in the wastes, then the whole mine is instantly filled with the most brilliant lightning; the expanded fluid drives before it a roaring whirlwind of flame, which tears up every thing in its progress, scorching some of the miners to a cinder, and burying others under enormous heaps of ruins shaken from the roof; then, thundering to the shafts, it wastes its volcanic fury in a discharge of thick clouds of coal-dust, stones, timber, and not unfrequently, the limbs of men and horses." But this, though apparently the most terrible, is by no means the only effect of these subterranean thunderings. "The stoppings and trap-doors of the mine being blown to atoms by the violence of the explosion, and the ventilation being destroyed, those who happen to survive the fire-damp, fall immediate sacrifices to the "after-damp,"* which fills up the chasm occasioned by the explosion."

It was on the principle of the low specific gravity of the fire-damp that I suggested a Safety Lamp, interesting, I believe, as being the *first mechanical invention* ever proposed. About this period Sir H. Davy contemplated illuminating the mine with the *light of phosphorus*. Indeed, I was among the earliest in the field, and received TWO VOTES of thanks for my researches and communications, from "the society for the prevention of accidents in coal mines." My little work which contained the proposition was before the public in June, 1815, and Mr. Hodson, in the controversy which ensued on the question of priority of invention in Safety Lamps for mines, states, that Sir H. Davy himself had pointed out to him the passage in my little volume which contained the suggestion. Sir H. Davy says, in a letter to me, "I discovered my principle of security about the middle of October, 1815, and had applied it to lamps with apertures and tubes before the end of that month. About the middle of November I discovered the power of wire gauze to prevent explosion, and the wire gauze Safety Lamp was perfected toward the close of that month." It should be remarked that some years previous to this period, Mr. Smithson Tennant and Dr. Wollaston had discovered that capillary tubes intercepted explosion. Figure IV. in the plate will afford a tolerable idea of the plan suggested by me. I quote the precise words proposed in the first edition, p. 154 of my "Elements of Chemical Science," bearing date June 20, 1815, "a pipe might supply an air-tight lamp from the mine itself; and the orifice of the tube receive its supply from *the stratum of air contiguous to the floor*: the carburetted hydrogene, being *lighter* and *ascending*, would occupy the roof, and thus could not enter the tube." This language is so clear and unequivocal that no sophistry can pervert its meaning, or evade its force. The late Dr. John Murray, of Edinburgh, read a paper before the Royal Society of that city, in November, 1815, with a *similar proposal*, consequently, he was anticipated by me, no less than *five months*, and without at all impugning the integrity of that meritorious individual, I may here state, that my little work had been, *four months* before this paper was read, in the possession of several of my friends in Edinburgh, though it does not at all follow that Dr. Murray had either seen or heard of it. One thing is certain,—the priority clearly belongs to ME; Sir H. Davy and others thought so, and expressed themselves to that effect. As to a simple typographical error, it cannot be supposed to weaken its force. If language has any meaning none can mistake the description I have quoted *verbatim*.

---

* The *carbonic acid gas* of modern chemistry, or the "choke-damp" or "black-damp" of the miner.

I have waived all allusion to the history of the controversy which ensued, as to the merit of priority in the Safety Lamp of Sir H. Davy, considering as I do that of the late lamented Davy to be clear and undisputed. Dr. Reid Clanny asserted a claim to priority; but what connexion there is between the wire gauze

Safety Lamp and Clanny's Steam Safety Lamp, I have yet to learn. The only one of Mr. George Stephenson's invention I ever saw, was in the laboratory of the Royal Institution. That it was altogether *unsafe*, there could not be the shadow of a doubt, and to my view bore no resemblance whatever to *the* Safety Lamp of Davy. Clanny's *original* lamp, was pointed out to me in the model room of the "Society of Arts."

The phenomena of the Safety Lamp are not the least interesting of the wonders of modern science. A cage of open net work in a tissue of wire, holding flame, as it were, bound and imprisoned within its cell. The resourses of mechanical ingenuity having been exhausted, the terrified miner, in consternation and alarm, petitioned the chemical philosopher to see whether these subterranean thunders could not be subdued by some agency obtained from the marvellous stores of his science. PROVIDENCE pointed to SIR H. DAVY,—the beautiful problem was solved, and the rejoicing miner saw at length his enemy in prison—shorn of his strength, and fluttering in a cage.* When we traverse the lone and dreary chambers and subterranean avenues of the mine, guided safely by means so slender, the mind is impressed with a powerful conflict of feeling, and the wonder is enhanced as we view the elements of explosive flame flashing in harmless coruscations within the circle which the WAND OF SCIENCE has described around the ANGEL OF DEATH.

---

* Let it not be supposed that I have written these pages save in the character of one contending for the TRUTH,—this is my "Achilles." Even Mr. Faraday is at *this moment* impugning Sir H. Davy's views of electricity, in reference to the experiments he made on the Torpedo at Genoa, and which I had already considered to be altogether equivocal and unsatisfactory.

FINIS.

Smart and Parke, Printers, Wolverhampton.

LIST OF WORKS BY

JOHN MURRAY, F.S.A. F.L.S. F.H.S. F.G.S., &c.

To be had of Messrs. Holdsworth and Ball, 1. Amen-corner, Paternoster-row, London.

I.

ELEMENTS OF CHEMICAL SCIENCE,

In 1 *vol.* 8*vo.* (Second Edition)—*price* 8*s.*

II.

PRACTICAL REMARKS ON MODERN PAPER, &c.

In 12*mo.*—*price* 4*s.*

III.

REMARKS ON THE CULTIVATION OF THE SILK-WORM.

In 8*vo.*—*price* 1*s.* 6*d.*

IV.

DESCRIPTIVE ACCOUNT OF A NEW SHOWER, BATH, AND AN APPARATUS FOR SUSPENDED ANIMATION,

In 8*vo., with a Plate* (Second Edition)—*price* 2*s.* 6*d.*

V.

RESEARCHES IN NATURAL HISTORY.

In 12*mo. with a Plate* (Second Edition)—*price* 6*s.*

VI.

A GLANCE AT SOME OF THE BEAUTIES AND SUBLIMITIES OF SWITZERLAND.

In 12*mo.*—*price* 7*s.*

VII.

A TREATISE ON ATMOSPHERICAL ELECTRICITY, &c.

In 12*mo. with a Plate,* (Second Edition)—*price* 6*s.*

VIII.

REMARKS ON THE DISEASE called HYDROPHOBIA.

In 12*mo.*—*price* 4*s.*

IX.

A TREATISE ON PULMONARY CONSUMPTION.

In 8*vo.* (Second Edition) *price* 8*s.* 6*d.*

X.

AN INVENTION FOR SAVING FROM SHIPWRECK, &c.

In 8*vo. with a Plate*—*price* 2*s.* 6*d.*

(ALSO, A SUPPLEMENT, DESCRIPTIVE OF NEW EXPERIMENTS.)

XI.

A MEMOIR ON THE DIAMOND.

In 12*mo. with a Plate*—*price* 5*s.*

XII.

PRACTICAL OBSERVATIONS ON FLAME, &c.

In 8*vo. with a Plate*—*price* 1*s.* 6*d.*

XIII.

THE TRUTH OF REVELATION,

DEMONSTRATED BY AN APPEAL TO EXISTING MONUMENTS, SCULPTURES, GEMS, COINS, AND MEDALS.

In 12*mo. with Plates and Wood Cuts*—*price* (*cloth*) 10*s.*

XIV.

In the Press, Third Edition of

A MANUAL OF EXPERIMENTS ILLUSTRATIVE OF CHEMICAL SCIENCE.

With an Explanatory Plate and Wood Cuts.